



*Energy &  
Environmental  
Research  
Center*

## *Cofiring Biomass with Lignite Coal*

Darren D. Schmidt, Project Manager

Sean I. Plasynski, DOE NETL Project Officer

# *Cofiring Biomass with Lignite Coal*

Goal: Demonstrate the feasibility of cofiring biomass with a lignite coal in a grate-fired system.

## *Project Objectives*

- Perform a technical and economic feasibility study on cofiring wood waste with lignite at the North Dakota State Penitentiary.
- Obtain the first research data on the impact of cofiring biomass fuels with lignite coal
- Provide a demonstration to other state institutions and small stoker-fired systems.
- Provide research data for lignite utilities.

## *Basic Project Phase Budgets*

- Phase 1 – Feasibility Study, \$200,000 total  
(\$160,000 DOE, \$40,000 North Dakota State  
Penitentiary)
- Phase 2 – Demonstration, \$1.5 million

## *Project Members*

- EERC
- DOE
- North Dakota State Penitentiary (North Dakota Department of Corrections and Rehabilitations)
- North Dakota Department of Community Services
- King Coal Furnace Corporation
- K.J. Schwartz Engineering

## *NDSP Steam Plant*

- Fires 2600–2800 tons/yr lignite coal, 72% efficiency.
- Saturated steam at 100 psig is provided seven months of the year (shutdown May–October).
- Capacity of 200 psig, 28,000 lb/hr.
- Backed with two gas boilers and fitted with an electrostatic precipitator.
- Coal is 1½ stoker coal @ 34% moisture, 6% ash, 43% carbon, 3% hydrogen, 0.3% sulfur, 0.7% nitrogen, 13% oxygen, 7240 Btu/lb.
- Annual cost of operation: \$48,000 (with 2600 tons/yr @ \$18.50/ton).

## *Available Local Biomass*

- 500 tons/yr of municipal solid waste from the City of Bismarck's landfill.
- Residuals from a local pallet manufacturer.
- Waste paper from state facilities.

# *Project Task Structure*

## *Phase 1 – Feasibility*

- Task 1 – Local Biomass Resource Assessment
- Task 2 – Fuel-Handling Issues
- Task 3 – Fireside Issues
- Task 4 – Environmental Issues
- Task 5 – Energy Production Assessment
- Task 6 – Engineering Economic Analysis

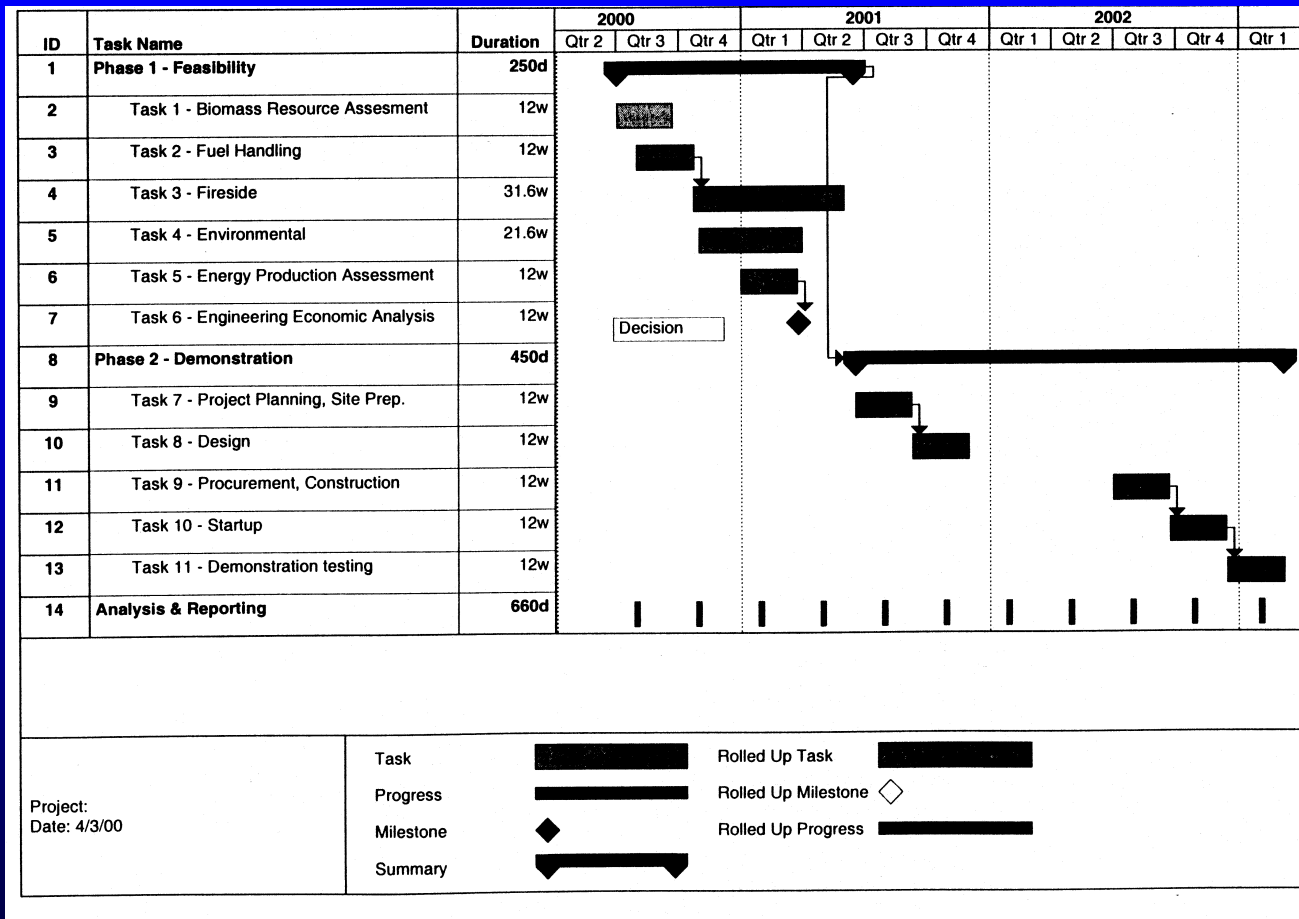


# *Project Task Structure*

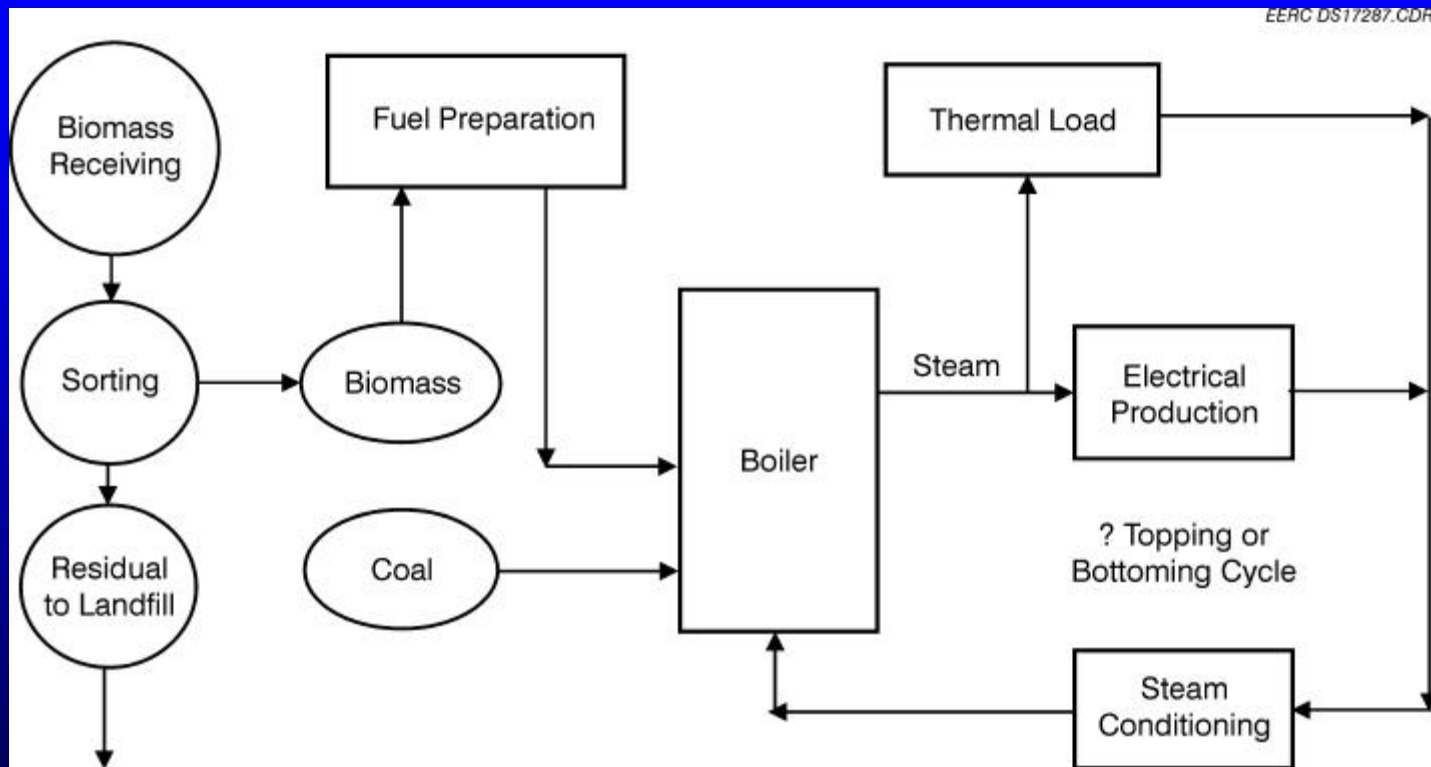
## *Phase 2 – Demonstration*

- Task 7 – Project Planning and Site Preparation
- Task 8 – Engineering Design and Preliminary Fuel-Handling Equipment Testing
- Task 9 – Procurement and Construction Activity
- Task 10 – Start-Up Equipment Testing
- Task 11 – Demonstration Testing, Data Collection, and Analysis

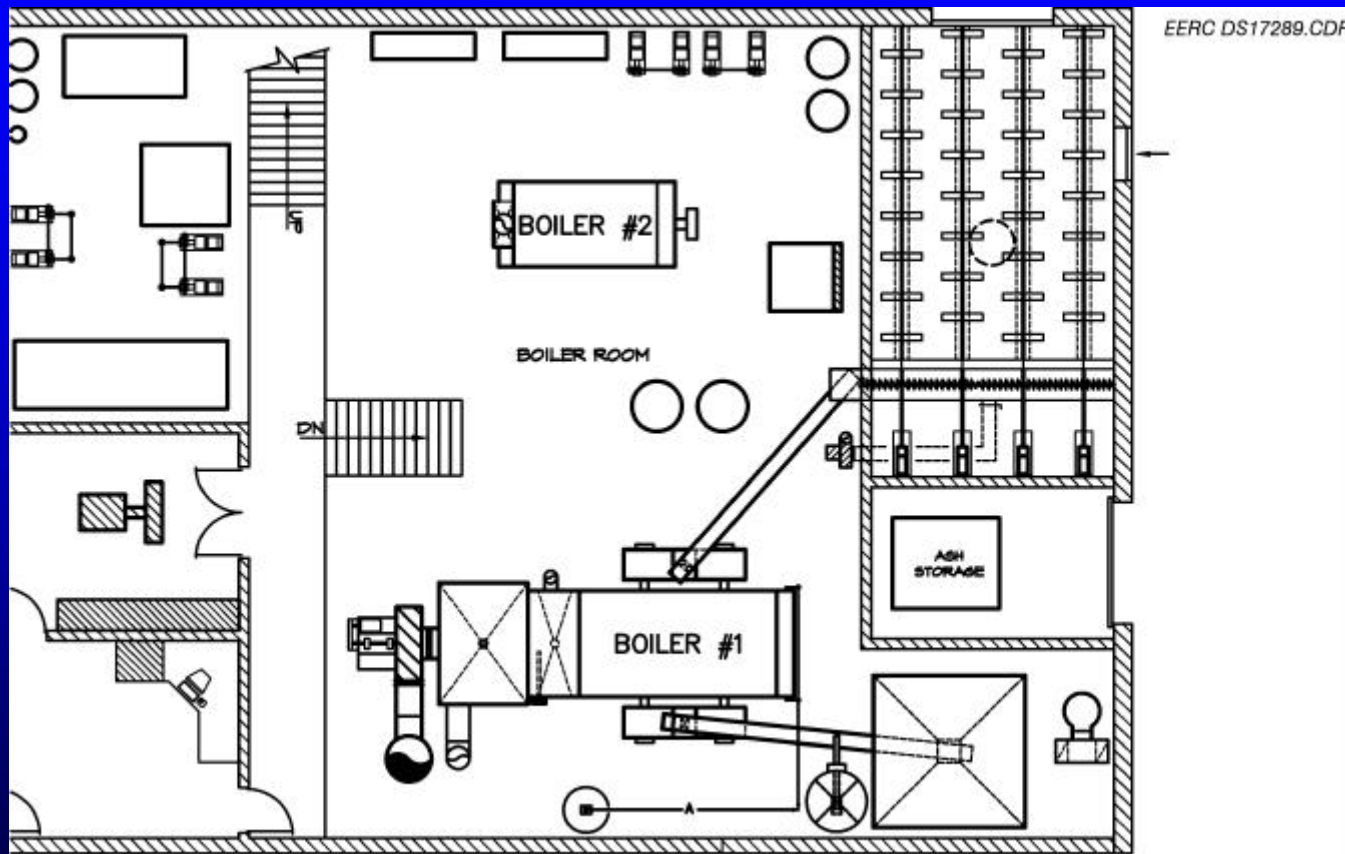
# Project Timeline



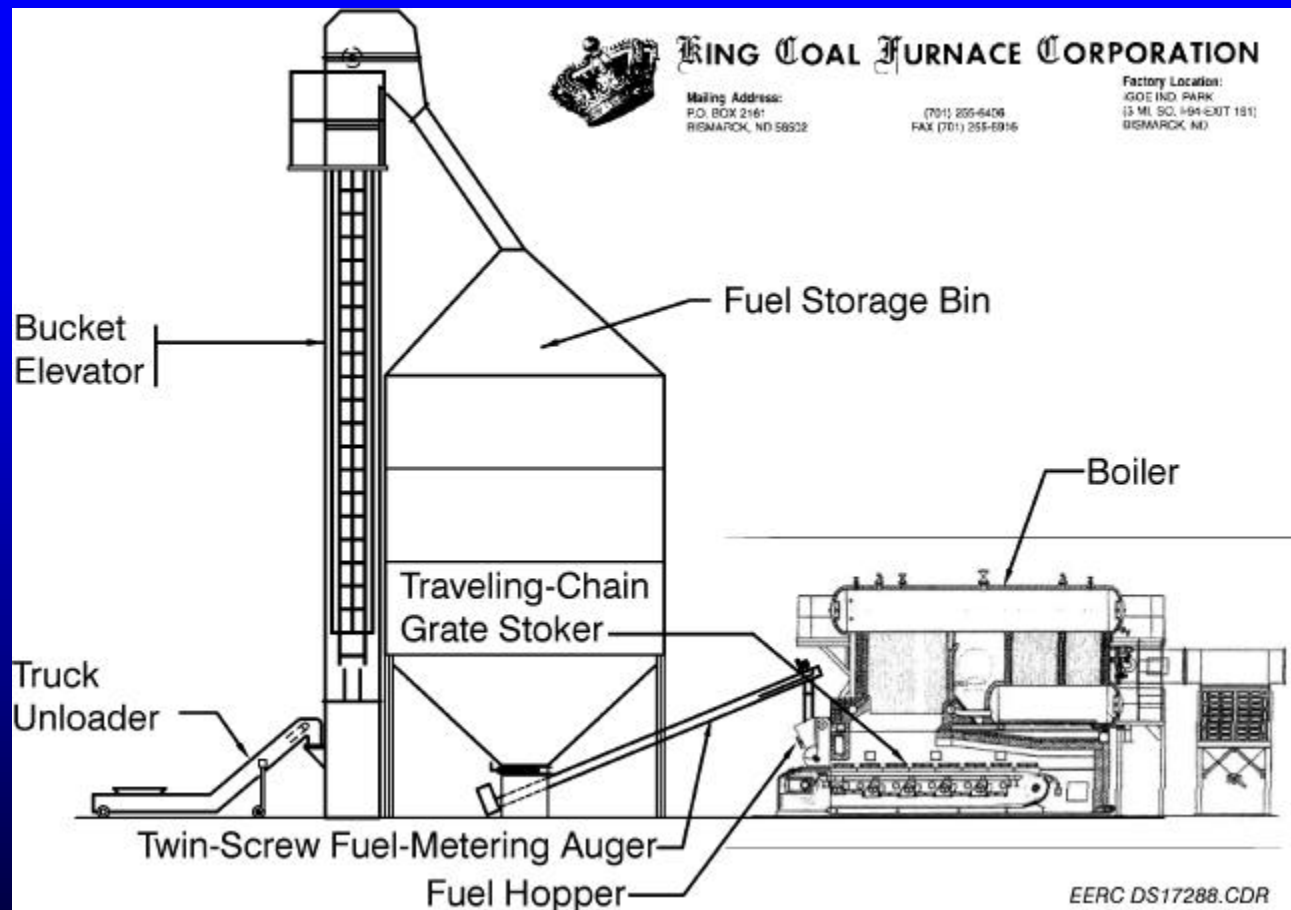
# Conceptual Cogeneration Plant



# King Coal Biomass-Handling System



## King Coal Chain Grate Stoker Modification



## *Project Members*

- EERC
- DOE
- University of North Dakota Facilities
- University of North Dakota Chemical Engineering Department
- North Dakota Department of Community Services

## *UND Steam Plant*

- Fires 45,000 tons/yr (subbituminous) for over 200 buildings.
- Saturated steam at 130 psig is provided year-round.
- Three water tube spreader stoker boilers (13,000 lb/hr coal, 65,000–75,000 lb/hr steam).
- Four gas-/oil-fired boilers (three at 60,000 lb/hr steam, one at 30,000 lb/hr).
- Separate multicyclone units with a common sidestream baghouse for emissions control.
- Coal is subbituminous, 2 × ¼ stoker coal @ 8500 Btu/lb, 0.6% sulfur, 8.3% ash, 25% moisture.

## *Available Local Biomass*

- 13,000 tons/yr of yard waste and brush, diverted from the Grand Forks City Landfill.
- University of North Dakota generates 300 tons/yr waste paper, as well as wood and municipal solid waste.
- Potential cost savings of \$337,000/yr, paying off a \$1.7 million investment in 5 years.



# Current Fuel Consumption for Electric Power in the U.S.

Renewables-  
not including  
biomass  
(Hydro)  
11%

Nuclear  
18%

Gas  
9%

**Biomass**  
**2%**

Petroleum  
3%

Coal  
57%

## Biomass use is:

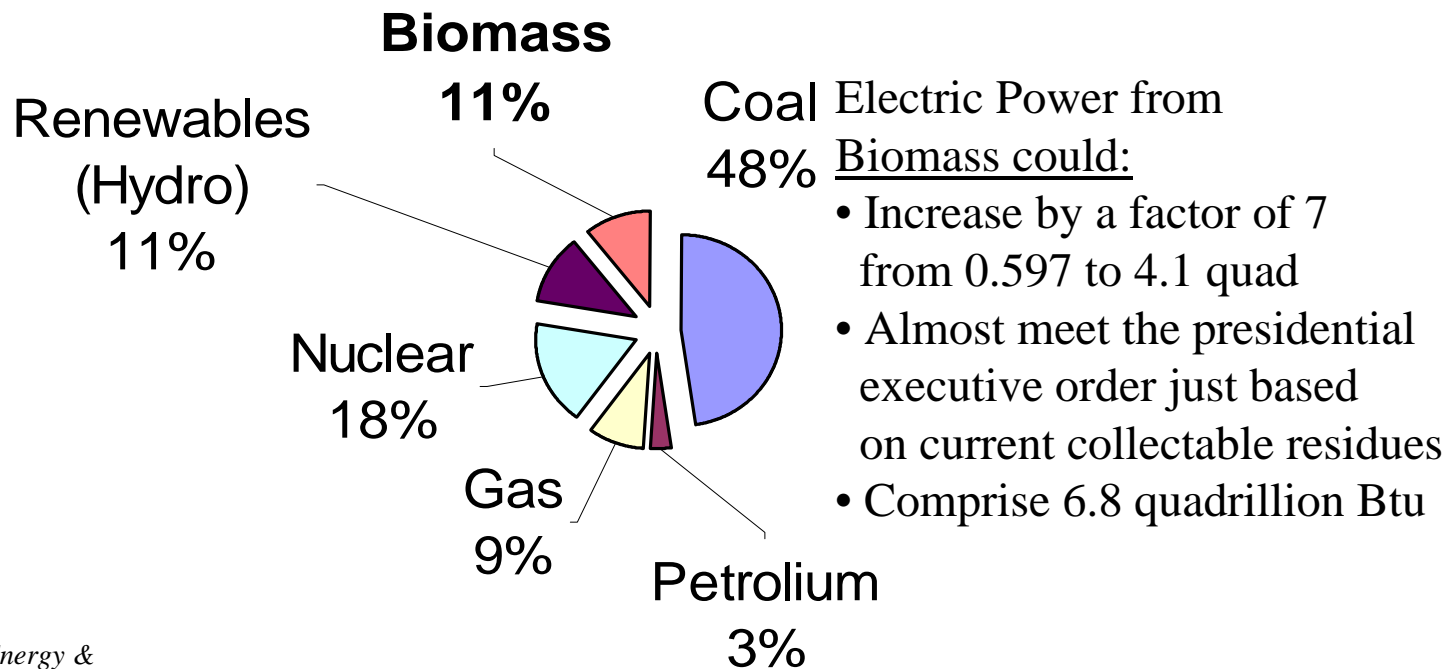
22% of total biomass  
for elec. power  
38% of total renewable  
energy  
2.7 quadrillion Btu  
97% of biomass elec.  
from cogen, IPP,  
& small generators  
125 U.S. powerplants  
Typically < 50 MWe



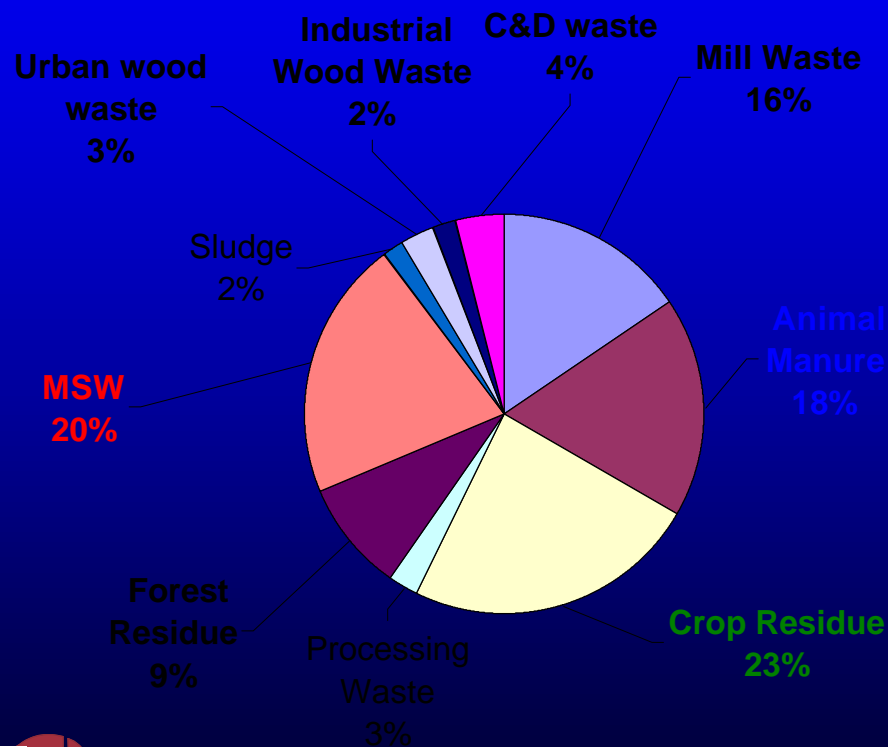
Energy &  
Research  
Center

EIA

# Potential Use of Biomass for Electrical Generation



## Results of Quantification



34% Wood  
20% MSW  
26% Ag residue  
18% Manure  
2% Sludge



*Energy &  
Environmental  
Research  
Center*

University of North Dakota  
Grand Forks, North Dakota

**In order to make effective use of biomass for electricity production, power plants must be small, designed to utilize a residue source, and have a minimal capital and operation expense.**